Modelling Energy System Investment Planning: A Methodological Perspective

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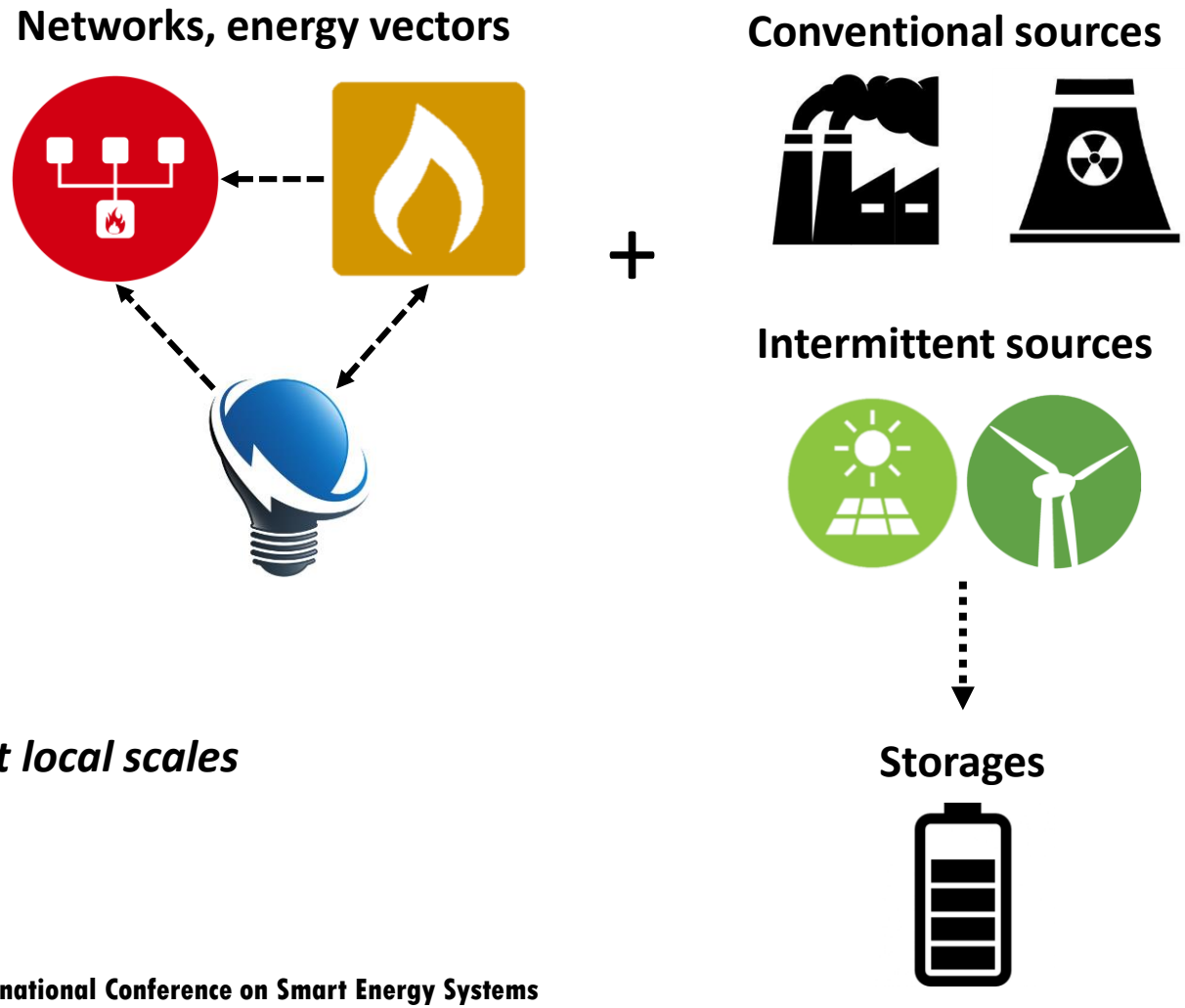
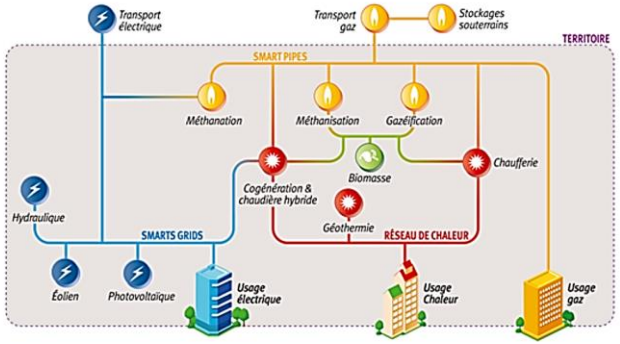
Energy Systems Investment Planning: Need for Modelling

- Moving to sustainable energies
- Requires long term planning
- For complex systems
- At large and smaller scales



Decentralization trend → need for planning at local scales

Modelling for decision making:



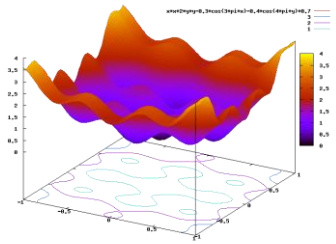
Real System Question(s)

Techno-economic Model

Accuracy

Information level

Optimized Solutions



How current methods perform?

How to consider high renewable shares and (seasonal) storages?

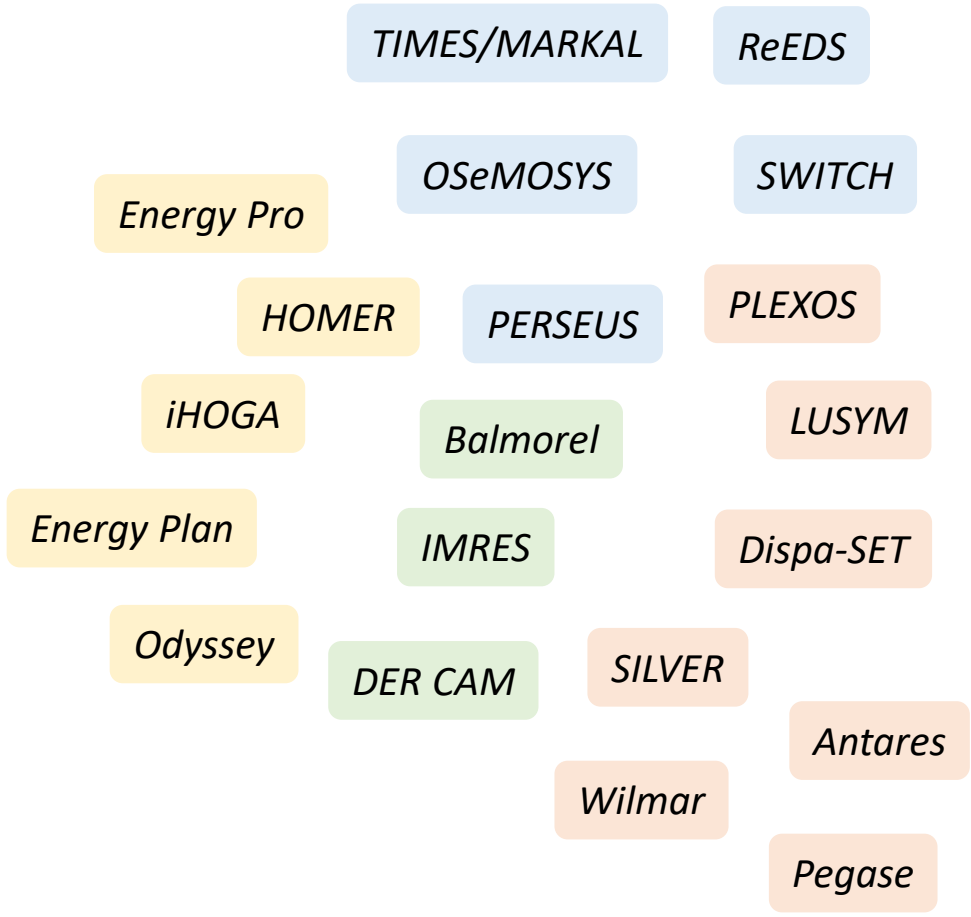
Review of (bottom up) modelling methods: from local to national scale

- Current tools and generic models

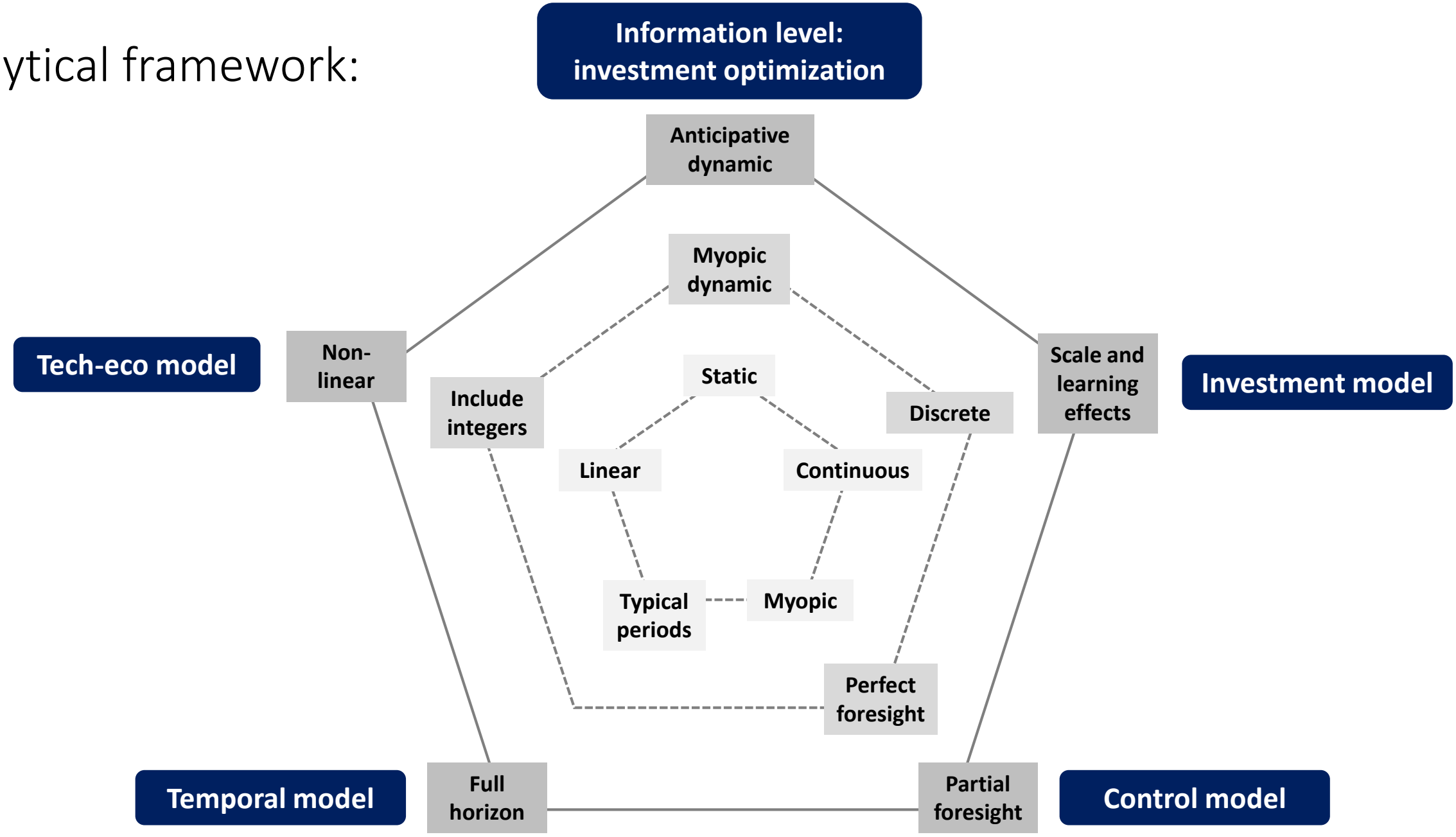
- Energy system planning studies with specific models (~ 60 papers)

- Methodological focuses, reviews, thesis etc. (~ 60 papers)

→ *Definition of an original analytical framework*



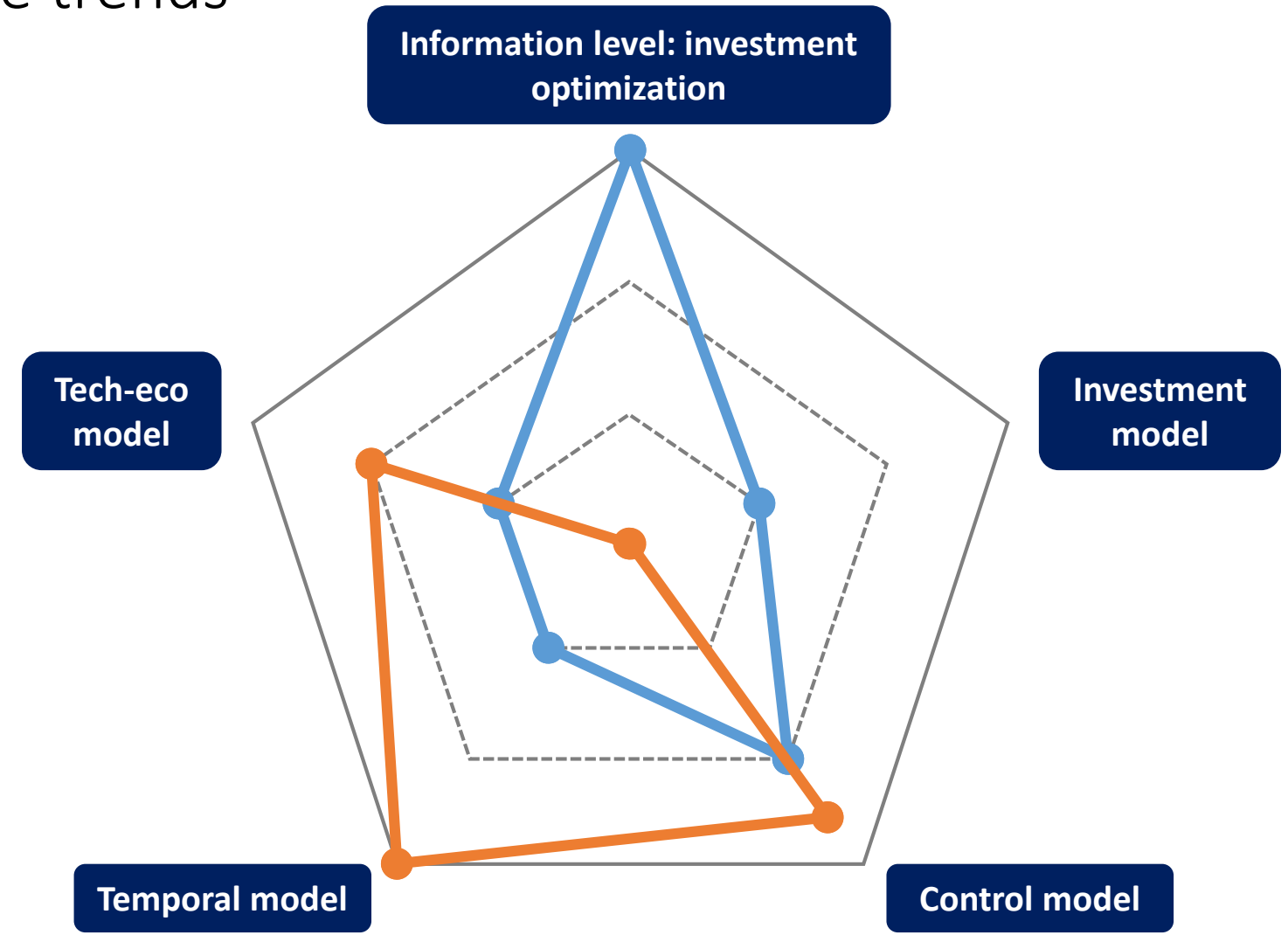
Analytical framework:



Modelling approaches: some trends

LP + Typical Periods — TIMES, OSeMOSYS

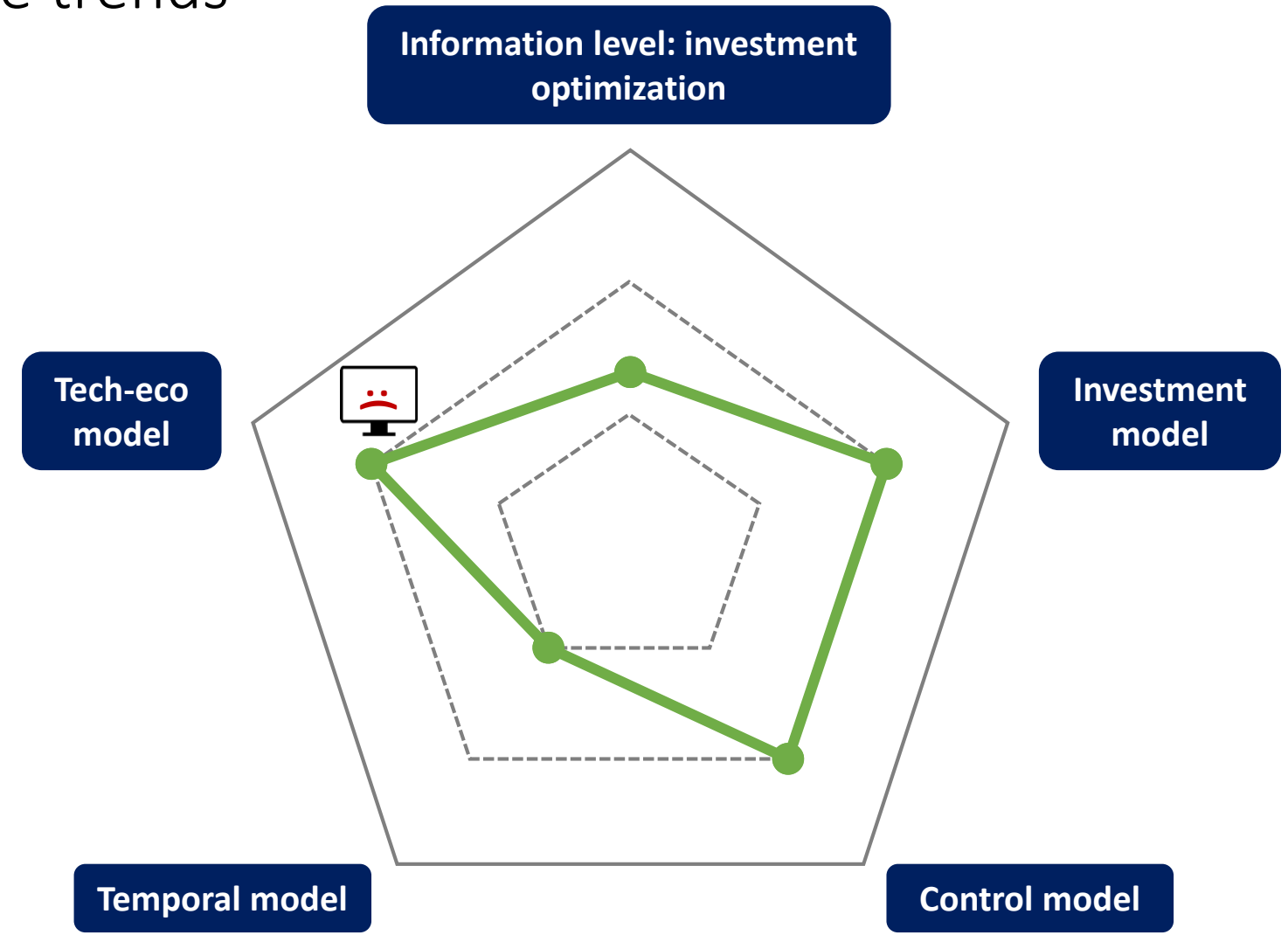
Operational MILP (+ Rolling Horizon) — PLEXOS, LUSYM, Antares



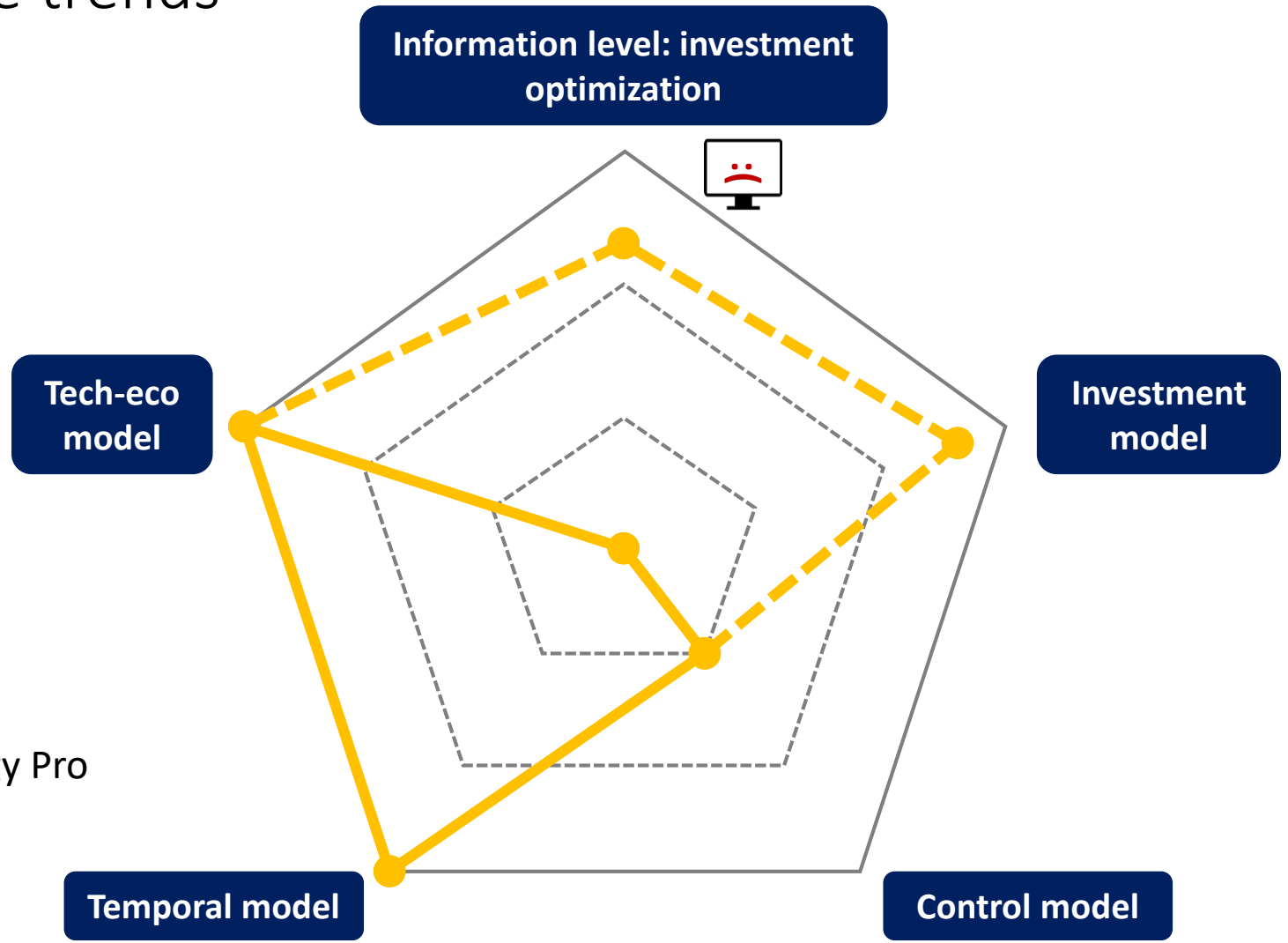
Modelling approaches: some trends

MILP
+ Typical Periods

IMRES, DER CAM



Modelling approaches: some trends

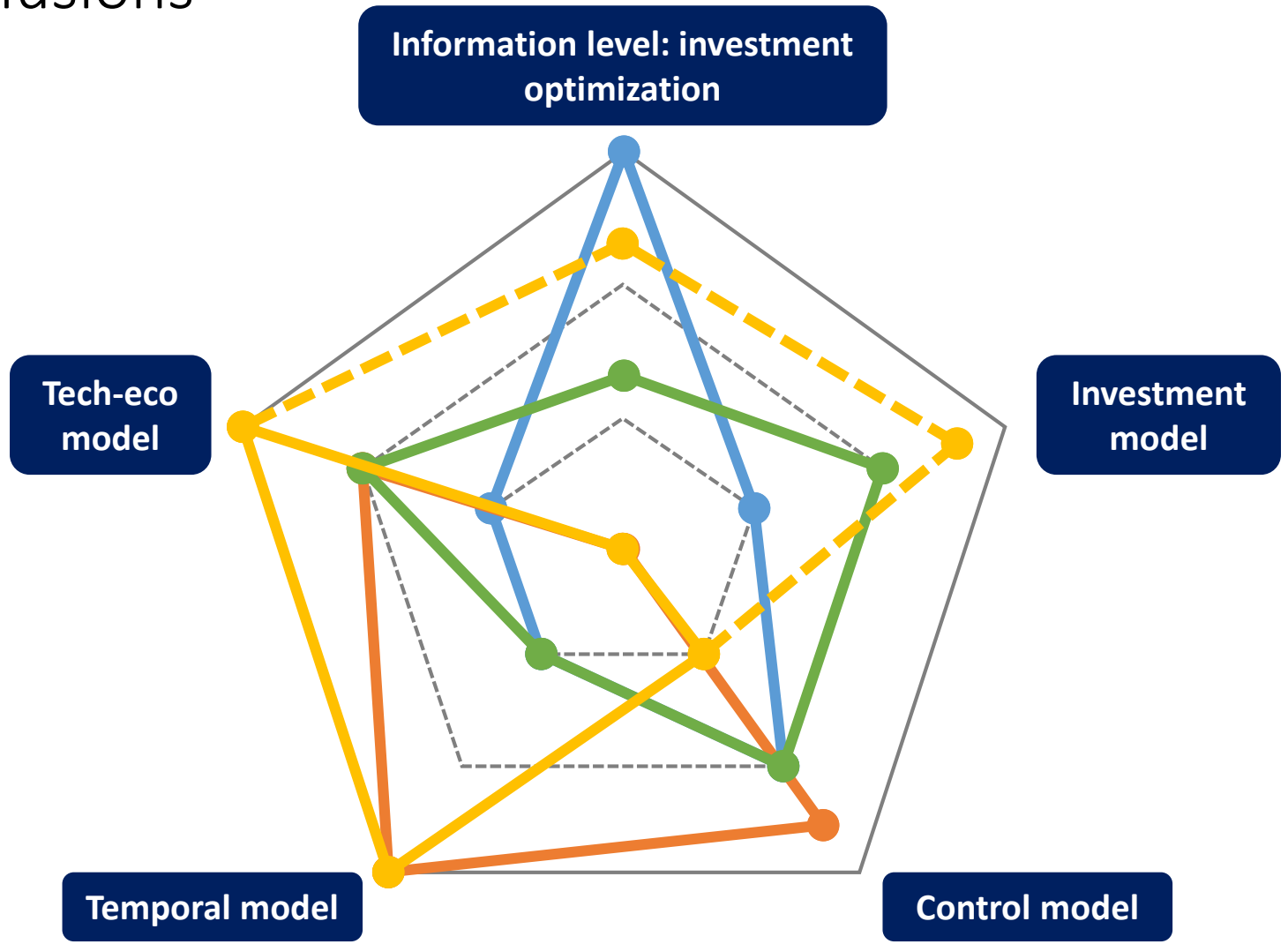


Simulation Model + Control Rules (+ Metaheuristic)

iHOGA, HOMER, Energy Pro
Energy Plan, Odyssey

Modelling approaches: conclusions

How current methods perform?



How to consider high renewable shares and (seasonal) storages?

Control decisions:

Dispatch, power levels

Start-up, shut-down
(Unit Commitment)

Market purchases, sells

Control Rules
« if, then, else »

Myopic: sub-optimal use of storages

Predictive Control:

Mathematical programming formalism

~~Perfect foresight hypothesis~~ critical if:

- High uncertain production shares
- Long-term foresight (storage)

« On/off » or « yes/no » decisions

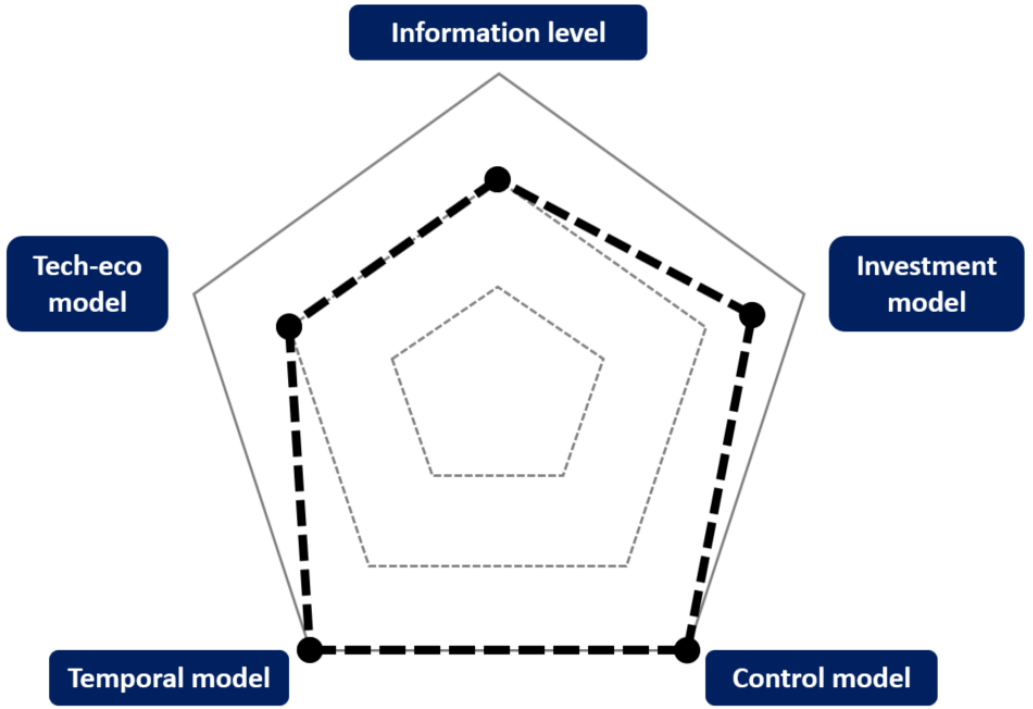
« Start-up/shut-down » decisions

Non-linear behaviours

Important to account for (lack of) flexibility!

Review conclusions and research orientations:

- Wide variety of methods, some main trends
- Compromises: information level / accuracy / computation times



Our targets: small scales (individual up to urban)

- Optimize investment decisions (far ahead, up to 2050)
- Consider realistic system operation dynamics (flexibility, costs, UC)
- Consider realistic forecast hypothesis and seasonal trends

Alternative method under investigation

Review article in writing stage

Thank you for your attention!

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